ASRVN Surface Reflectance: A New Science and Validation Data Set

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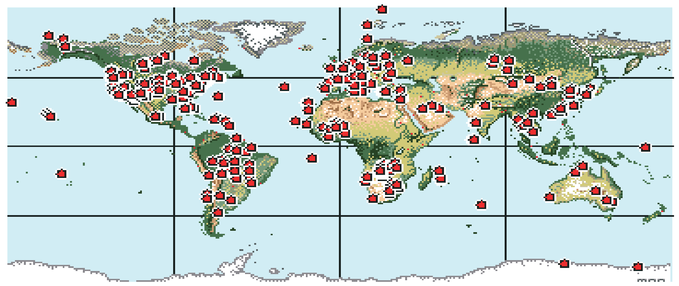
Overview

The AERONET-based Surface Reflectance Validation Network (ASRVN) is an automated system that 1) operationally receives MODIS, MISR, etc. measurements for about 160 AERONET sites globally (subset area of 50×50 km^2), and AERONET aerosol and water vapor data, and 2) performs accurate atmospheric correction to retrieve surface BRF and albedo.



The ASRVN products, stored in the gridded format at 1 km resolution, are:

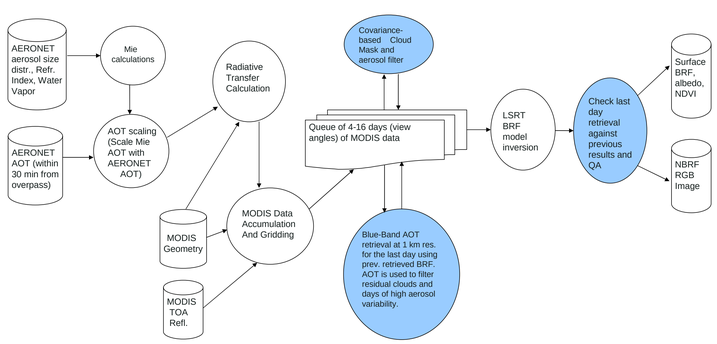
–*Spectral Surface BRF and Albedo;*
– *RGB Images of the NBRF (BRF at nadir and SZA=45º) and IBRF (Instantaneous BRF for a geometry of the latest satellite observation)*
–*To come: PAR, Shortwave Surface Irradiance and Shortwave Broadband Albedo.*

Main application of ASRVN:

- *Land Product Validation for MODIS and NPP/NPOESS (Surface Refl. and VIs)* *(Lyapustin, A., Y. Wang, J. Martonchik, J. Privette, et al, 2006: Local Analysis of MISR Surface BRF and Albedo over GSFC and Mongu AERONET Sites. IEEE TGARS **44**, 1707-1718);*
- *Calibration Support:*
  - *cross-instrument calibration. Methodology for the sensors flying on the same platform (MODIS TERRA – MISR) has been developed (Lyapustin, A., Y. Wang, R. Kahn, J. Xiong et al, 2007: Analysis of MODIS-MISR calibration differences using surface albedo around AERONET sites and cloud reflectance. RSE, **107**, 12-21).*
  - *Methodology for the sensors flying on different orbits (ASRVN albedo-matching method) for MODIS TERRA – AQUA will be developed shortly.*
  - *Detection of long-term calibration trends based on the time series analysis.*
- *Science analysis in support of aerosol retrievals and atmospheric correction.*
- *Application analysis in land disciplines.*

ASRVN MODIS Algorithm

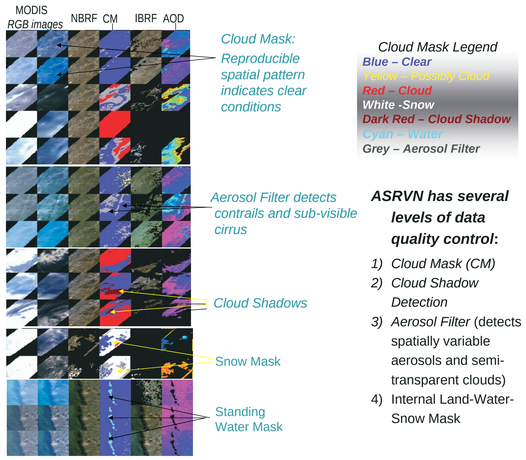
The algorithm first accumulates up to 16 days of TOA MODIS measurements, and then makes inversion for surface BRF/Albedo using Li-Sparse Ross-Thick (LSRT) model.



Blue color: Extensive data quality analysis

Processing Examples

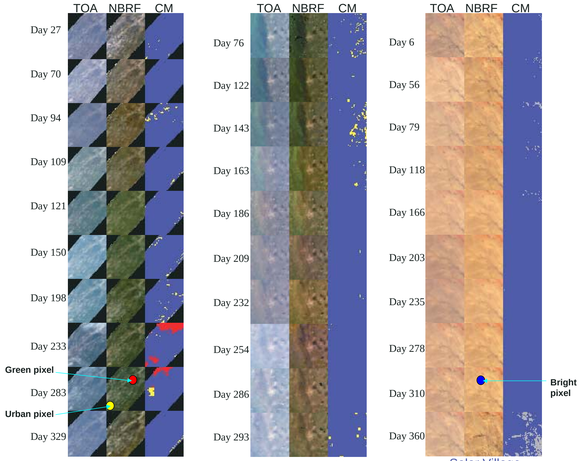
Multi-level Data Quality Assurance



***ASRVN has several levels of data quality control*:**

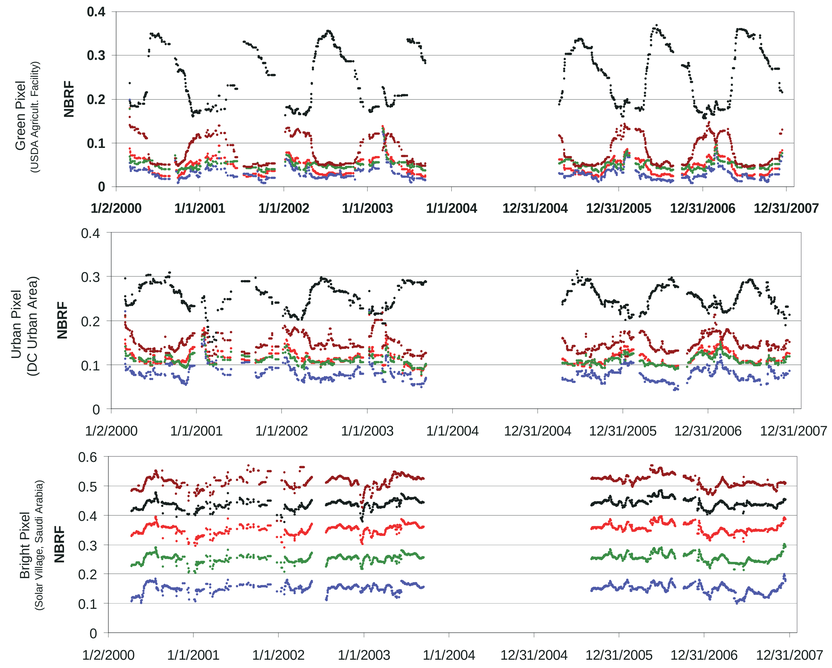
1) *Cloud Mask (CM)*
2) *Cloud Shadow Detection*
3) *Aerosol Filter* (detects spatially variable aerosols and semi-transparent clouds)
4) Internal Land-Water-Snow Mask

Seasonal dynamic of surface



GSFC, MD, USA, 2005 | Mongu, Zambia, 2005 | Solar Village, Saudi Arabia, 2006

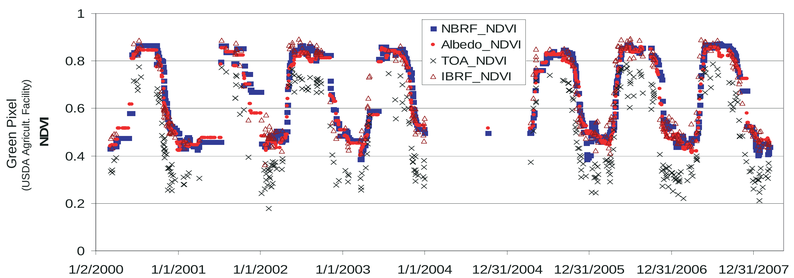
NBRF (BRF @ nadir and SZA=45º) Time Series for a Single Pixel



Legend: Blue (B3), Green (B4), Red (B1), NIR (B2), SWIR (B7).

The time series of NBRF for a single pixel shows a low retrieval noise and a highly reproducible annual pattern.

NDVI Time series for a Single pixel

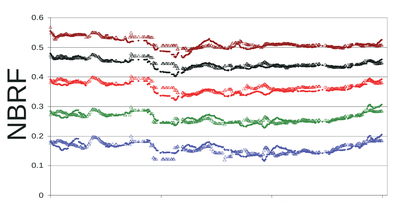


TOC NDVIs computed with different ASRVN products (NBRF, albedo, IBRF) vs TOA NDVI

➢The NDVIs derived from NBRF and albedo are similar and very stable. The NDVI derived from IBRF tracks seasonal variations faster, but shows higher variability due to variations of viewing geometry.

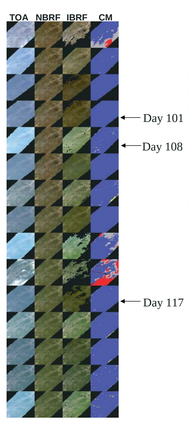
➢The TOA NDVI shows a high noise and significantly lower values as compared to TOC NDVI computed from atmospherically corrected surface reflectance.

Towards X-calibration: MODIS TERRA vs AQUA



MODIS Terra vs. Aqua NBRF for a bright pixel (Solar Village). Here, triangles and solid circles represent Aqua and Terra NBRF, respectively. Red, green and blue bands are shown with their respective color. Black and brown represent NIR and SWIR (2.1μm) bands, respectively.
An initial comparison of ASRVN NBRF from MODIS TERRA and AQUA shows a good agreement. The ASRVN sensor-specific records can be used for cross-calibration of instruments flying on different orbits (e.g. MODIS TERRA vs AQUA).

NBRF vs. IBRF



GSFC, MD, USA, 2006

The NBRF is retrieved using 16 day interval. It is a high quality product, but its response to surface changes can be delayed. The IBRF is derived using the last day of measurements, tracking the spectral changes immediately. This makes the IBRF much more sensitive to the seasonal variations of ecosystems and rapid surface changes.

The figure on the left shows the difference in the time response of NBRF and IBRF during spring green-up.

Concluding Remarks

•The ASRVN is an operational system since 2006. Its algorithm has evolved. The current version, providing high quality results, has an extensive mechanism of data quality analysis, including cloud mask, filter inhomogeneous aerosols and semi-transparent clouds, and control of the time series consistency of surface BRF and albedo.

•The ASRVN dataset for available 7 years of MODIS TERRA and ~2 years MODIS AQUA data is available for public use. They will be stored at MODAPS (coordinated by R. Wolfe). The products are accompanied with Quality Assurance (QA) flag and color-composite RGB browse images.

•The ASRVN dataset can be used for validation and science analysis as well as for the sensor calibration support. Currently, the work is underway to test the accuracy of the new MAIAC atmospheric correction algorithm, in comparison to MODIS operational MOD09 and MOD43 products.